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TECHNICAL REPORT 9123

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Redesign of the Field Dental Bag to Accommodate Dental Instruments,
Supplies, and the Battery Operated Dental Handpiece.

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Robert R. Brewer

24 October 1991

U S ARMY BIOMEDICAL RESEARCH & DEVELOPMENT LABORATORY

Fort Detrick

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) It is United States Marine Corps (USMC) policy for the corpsman to use the M-3 aid bag as an emergency dental kit. The USMC incorporated a dental handpiece into the kit, which mandated the design of a new dental bag. A prototype was designed by the U.S. Army Biomedical Research and Development Laboratory, which accommodates the handpiece and ancillary supplies. In addition, it has two pouches: one for exploratory instruments and one for surgical instruments. All metal fixtures and zippers were replaced with plastic ones, the position of the carrying strap was moved to improve stability, and short handles were added to the sides. This design was accepted by the USMC, and a technical drawing package was furnished to them.			
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Introduction

It is United States Marine Corps (USMC) policy for the corpsman to use the M-3 aid bag (NSN 6545-00-912-9870) as an emergency dental kit. The official nomenclature for the M-3 is "Case, Medical Instrument and Supply Set". No significant changes have been made to the M-3 aid bag in twenty years. It is made of nylon fabric with metal hardware as illustrated in Figure 1. Its basic three pocket, trifold design is familiar to combat life support personnel serving over the last three decades.

The USMC incorporated a battery operated dental handpiece (NSN #6520-01-239-4696) as well as additional expendables into their emergency dental instrument and supply set. The handpiece has an approximate volume of 138 in³. The approximate volume of the M-3 Aid Bag is 340 in³. This 40 percent increase in required volume mandated the design of a new dental bag specific to the needs of the USMC.

A November 27, 1989, memorandum from the Commandant of the Marine Corps (see Appendix) requested that the United States Army Biomedical Research and Development Laboratory (USABRDL) design a new dental bag to accommodate the additional accessories and in corporate the recommendations listed in Table 1. This technical report describes efforts in development of the dental case to meet the USMC criteria.

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Methods and Materials

A market survey was conducted to determine the availability of various types of equipment cases, trauma bags, and paramedic kits with particular interest being directed toward a containment system for emergency treatment equipment. Fifteen potential manufacturers were identified in the market survey, but none of the available products met USMC requirements. Therefore, a development effort was initiated to make a prototype and provide the USMC with a technical drawing package.

The first step in prototype development was to categorize the dental set contents according to purpose: exploratory, surgical, and medications. Table 2 lists the dental components packed into the M-3 Aid Bag; categorized by the compartments in which they are usually stored. The USMC revised this list, deleting the 53R tooth extracting forceps and adding the dental handpiece and five packages of burrs.

The second step in development was the choice of materials used in construction of the bag. The outer shell material should be tough, and the instrument pouch material should be puncture resistant and sterilizable. Lift point hardware should be rugged, and all materials should meet or exceed the standards set forth for the M-3 aid bag (MIL-C-36856).

Results

Dimensions

The largest component in the set is the dental handpiece box, which measures 2.0 by 6.3 by 11.0 inches. The second largest item is the mixing pad of parchment paper, with dimensions of 0.25 by 6.0 by 8.0 inches. Taking into account the probability of putting the mixing pad in incorrectly and the advantage of additional volume for accessories, a length of 12.0 inches and a height of 8.0 inches were selected. The M-3 aid bag had a width of 4.25 inches. An additional 2.0 inches for the handpiece box and 1.25 inches for a folding instrument pouch gave a final depth of 7.5 inches. The dimensions 12.0 by 8.0 by 7.5 inches give a volume of 720.0 cubic inches.

Materials

The nylon fabric of the M-3 is adequate, but new and better materials have been developed since the M-3 was introduced. The market investigation revealed most emergency treatment bags are made of Cordura nylon. Although more expensive, Cordura is tough, water resistant, and will neither rot nor mildew, and for these reasons Cordura Plus nylon fabric was chosen as the outer shell material for the dental bag. The puncture resistant material selected for the pouches was a water proof, vinyl coated nylon called Herculite. It was chosen because of durability, stability to heat, and cleaning characteristics.

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In the M-3, the lift point hardware, zippers, and fasteners are made of metal. Advances have also been made in polymer technology, and plastic hardware was chosen because it is lightweight, rugged, and does not rust. The lift point hardware for the attachment of the shoulder strap was replaced with DuPont Delrin hardware consisting of a tri-ring, retainer, and hook. Plastic coil style zippers were chosen because they were found to be superior in strength to tooth style zippers. Compartments did not move relative to one another, so snaps or Velcro fasteners were not necessary. A small amount of Velcro was used to secure the flaps of the roll up pouches. Table 3 contains a list of materials used to construct the new dental kit.

The shoulder strap on an aid bag attach to two lifting points. The axis passing through these points (the axis of lift) is a reference line about which the bag rotates when acted upon by nonaxial forces (see Figure 2). The weight of the bag is a resultant force acting at the center of gravity of the bag. This resultant force has a radial and tangential component relative to the axis of lift. The tangential component causes rotation and, therefore, dictates stability.

If the bag has equal weight distribution, the center of gravity corresponds to the geometric center of the bag. An unequal weight distribution of packed materials can cause small

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shifts in the center of gravity from the geometric center. Because contents and packing procedures vary widely, aid bags should be designed around the concept that the center of gravity is generally at the geometric center. Viewed from above, the axis of lift of the M-3 aid bag is not centered, making the bag awkward to handle (see Figure 2).

In the prototype dental bags, the lift points were centered to ensure that the axis of lift passes above the geometric center of the bag. The lift points were also raised relative to the geometric center, which lowered the center of gravity and increased stability.

Organization of the interior

In the first prototype, the interior was divided into four compartments (see Figure 3). The rigid mixing pad in compartment 2, and the dental handpiece box in compartment 3 combined to provide structural support to the bag. Compartment 2 contained the disposables and smaller accessories. All exploratory and surgical instruments were located in pockets within a roll up pouch secured to the base of compartment 3 (see Figure 4). Velcro fasteners were used to hold the pouch in the folded position.

Second Prototype

In May 1990, the first prototype was presented to USMC representatives, and, in June 1990, it was presented to the Joint Services Dental Materiel Coordinating Group of the Defense Medical Standardization Board (DMSB). Suggested modifications

are listed in Table 4. All suggestions, except those involving the instrument pouches were readily incorporated into the design of the second prototype.

As recommended, instruments were categorized as exploratory or surgical, and two separate pouches were designed to accommodate the different instruments (see Figure 5). Whereas suggestion 2 called for a puncture proof material, there is no suitable material that is thin and flexible and completely resistant to the pressure generated at the point of a sharp instrument. Puncture resistant materials can be punctured, but the hole in the fabric does not propagate. The puncture resistant material selected for the pouches was Herculite.

In order to answer the question of sterilizability of the Herculite pouches, two test pouches were designed and fabricated: one was made entirely of Herculite, and the other was made of Cordura reinforced with Herculite. They were tested by placing sterilization assurance strips in the bottoms of each of the pockets and subjected to steam at 250°F for ten minutes. All strips recovered from the pockets of both types of pouches were sterilized. To maintain simplicity of design and reduce cost, pouches made entirely of Herculite were selected.

To accommodate instrument pouches, an additional fabric panel was added to the inner divider of compartment 3. It was tacked in the middle to form two pockets where the roll-up pouches would be secured (see Figure 6).

Summary

A field dental bag was designed by the U.S. Army Biomedical Research and Development Laboratory, which accommodates the hand-piece and ancillary supplies. In addition, it has two pouches: one for exploratory instruments and one for surgical instruments. Metal fixtures and zippers were replaced with plastic ones, the position of the carrying strap was moved to improve stability, and short handles were added to the sides. The final prototype was accepted by the USMC in November 1990, and a technical drawing package was furnished and accepted in February 1991.

REFERENCES

Memo: 6700 DEN00 27 NOV 89 From: Commandant of the Marine Corps
To: Commander, U.S. Army Biomedical Research and Development
Laboratory. Fort Detrick, Frederick, MD 21701-5012. Subject:
Redesign of the Dental Instrument and Supply Set, Emergency
Medical Treatment, Field, (Unit 2).

Mitchell, W., Knowles, M., and Bolduc, M. 1991. "Emergency Dental
Deployment Bag: Supporting the AirLand Battle." The
Journal of the U.S. Army Medical Department. March/April
pp.25-26.

Department of Defense. 1981. Human Factors Engineering Design for
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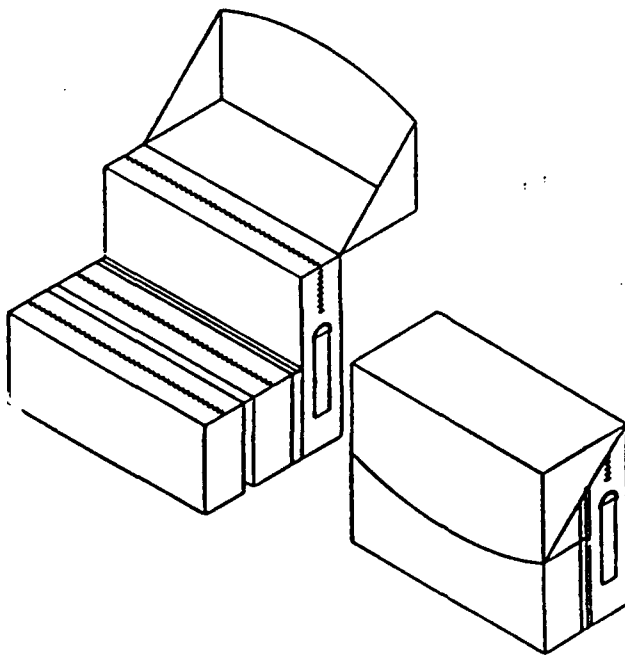


Figure 1. Sketch of the M-3 aid bag (NSN 6545-00-912-9870) showing the trifold design.

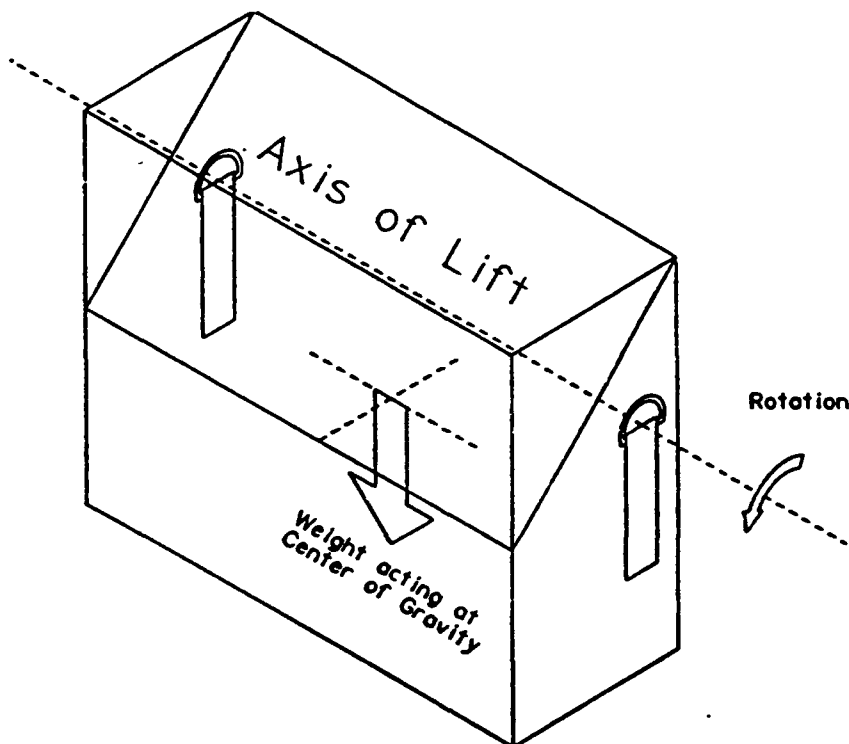


Figure 2. Stability and the Axis of Lift in the M-3 Aid Bag

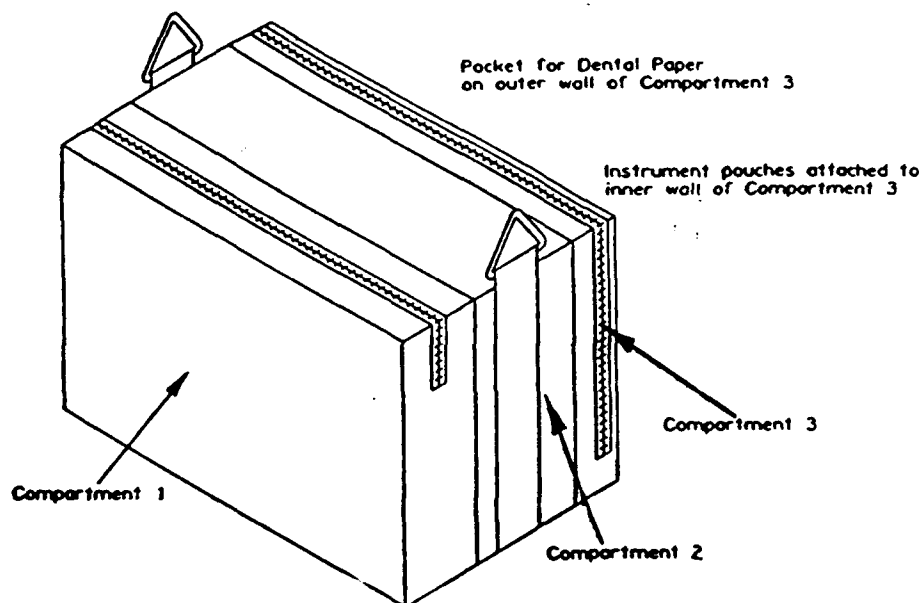


Figure 3. Sketch of the Compartment Layout of the First Prototype Field Dental Bag.

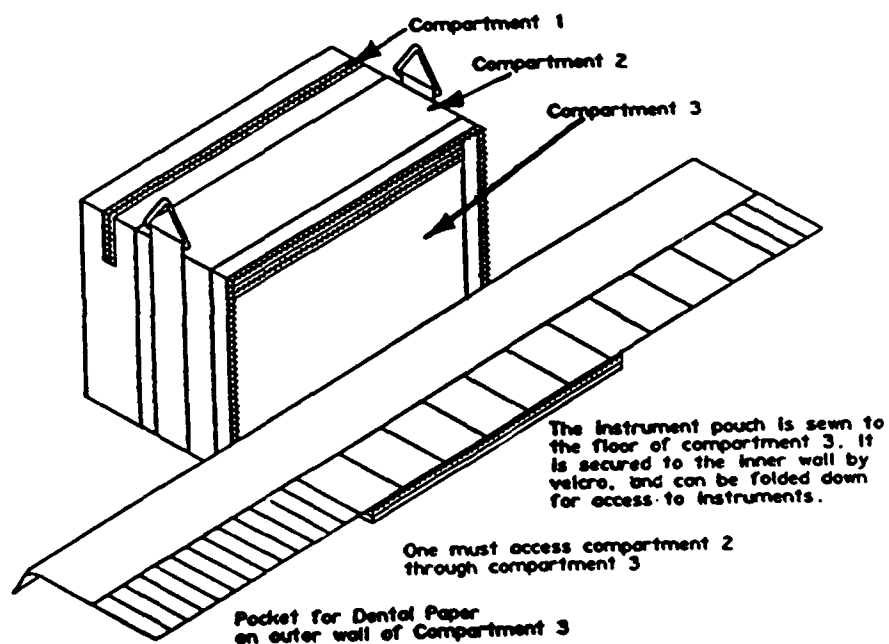


Figure 4. Sketch of the Fold Out Pouch of the First Prototype Field Dental Bag.

Technical drawing of a roof plan for a building. The drawing shows a central hall with a width of 10.00 and a length of 12.00. The wings are 4.00 wide and 7.00 high. The roof is divided into sections with a 'FOLD LINE' and 'Peak Valley 1.5' X .75' and 'Pile Valley 1.5' X .75' labels. The drawing includes dimensions for the roof sections and the building footprint.

Technical drawing of a roof plan for a building with a gabled roof. The drawing shows a rectangular footprint with a central gable. Dimensions include a total width of 17.00, a total depth of 12.00, and a gable depth of 4.00. The roof pitch is indicated as 1.5' x .75'. A 'FOLD LINE' is shown in the center. The drawing is labeled 'THRU SEEN' and 'THRU TOP'.

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New Dental Kit

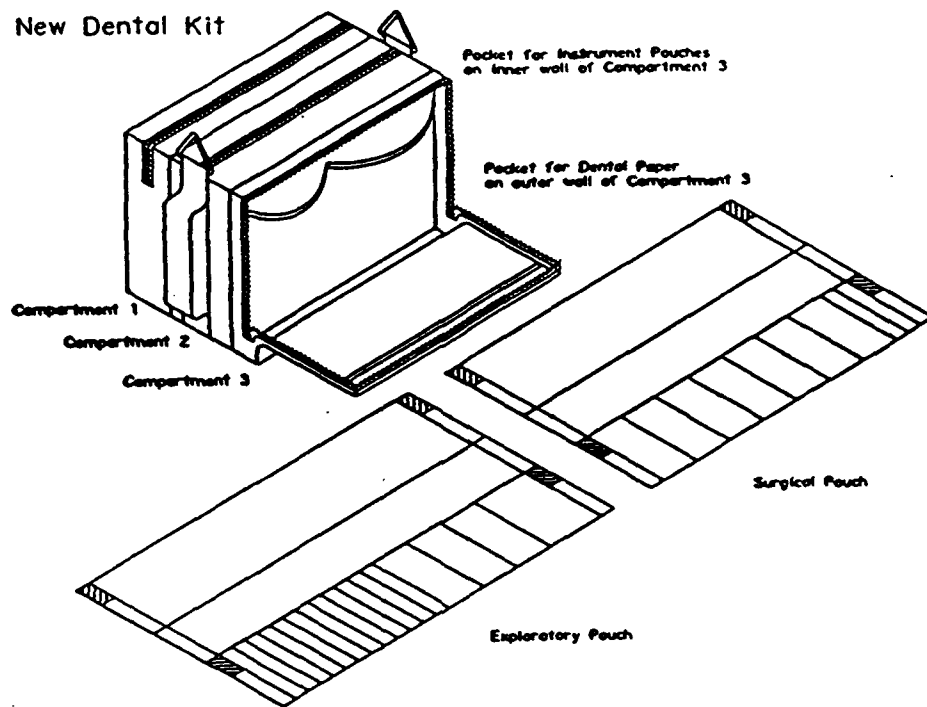


Figure 6. The Final Prototype Field Dental Kit.

Table 1.
U.S. Marine Corps Recommendations as provided
in Memorandum 6700 DEN00 (27 November 1989)

1. Change the position of the carrying strap to improve stability
2. Replace the metal closures with velcro fasteners.
3. Determine whether or not the dental instruments should be packed in metal or plastic cases.
4. Any other improvements that you may determine are appropriate, including the contents of the set.
5. Consider infection control requirements.

Table 3.
List of Materials to Construct New Dental Kit

ITEM	DESCRIPTION	NUMBER	COLOR
Thread	301 Stitch type Size F, Type I, Class I Polyester, z twist	NSN 8310-00-988-1300	O.D.
Overedge	Stitch type	504-SSA-1	O.D.
Fabric	Cordura Plus TM Nylon 1000/280 piece dyed		O.D.
Shoulder strap	1 1/2 in. Nylon tape Mil-T-5038F Type IV .75 oz., OD-7, Type IV	NSN 8305-00-263-2472	O.D.
Zipper tabs	3/8 in. Nylon tape single plain weave Mil-T-5038 Type III		O.D.
Zipper pulls	3/4 in. Nylon tape single plain weave Mil-T-5038 Type III 0.20 Oz., OD-7	NSN 8315-00-176-8083	O.D.
Zipper slider	No. 10 Size, single tab non-locking, YKK TM Mfg.	YKK101SBK	Blk.
Zipper	No. 10 Tooth nonseparating, roll length	YKK101BK	Blk.
Tri-ring Retainer Hook	made by Fastex TM made of DuPont TM Delrin TM size 1 1/2 inches	SN 1 1/2"	Blk.
Strap Slider	Triglides TM , 3 bar slide made by Fastex TM	TG 1 1/2"	Blk.
Velcro TM	Fastener tapes, Hook and loop, synthetic. 106 L.G. Hook # 80 Loop # 1000 Mil-P-21840G Type II		Lodin Green

Table 2.

Components of the Field Emergency Treatment
Dental Instrument and Supply Set

STOCK NUMBER	NOMENCLATURE	UNIT	QUANTITY
6545-00-912-9870	Case, Medical Instrument and Supply Set. Nylon, Non-Rigid, 10" X 4.25" X 8".	ea.	1
In Compartment 1.			
6505-00-106-0875	Ammonia Inhalant Solution, 1/3 ml ampoules.	pg.	1
6510-00-181-7732	Cement Zinc Oxide and Eugenol, Dental Ivory, 38 g.	pg.	1
6510-01-786-3736	Pad, Isopropyl Alcohol impregnated, 1.25" X 2"	pg.	20/100
6510-01-003-7697	Gauze, Absorbent, Iodoform .25" X 180".	pg.	1/12
In Compartment 2.			
6515-00-341-7200	Holder, Suture Needle.	ea.	1
6515-00-344-7800	Handle, Surgical Knife, Detachable, Carbon Steel.	pg.	2
6515-00-660-0008	Blade, Surgical Knife, Detachable, Carbon Steel.	pg.	2
6515-00-865-2687	Suture, Non-Absorbable, Surgical, Silk, Size 000.	pg.	1
6520-00-299-9671	Forceps, Dressing, Meriam 6 inch.	ea.	1
6520-00-524-2550	Elevator, Root, No. 34-S.	ea.	1
6520-00-524-3050	Elevator, Root, No. 301.	ea.	1
6520-00-528-1000	Explorer, Dental, No. 23.	ea.	2
6520-00-532-1050	Forceps, Tooth Extracting, No. 53R.	ea.	1
6520-00-046-7331	Scaler, Dental, Jacquette #1.	ea.	1
6520-00-536-5405	Plugger, Plastic Filling, Dental, Woodson, No.2	ea.	1
6520-00-541-9350	Handle, Mouth Examining Mirror.	ea.	1
6520-00-554-8150	Scissors, Collar and Crown, Straight, Universal, 4.5 in.	ea.	1
6520-00-584-2699	Elevator, Periosteal, Molt #9.	ea.	1
6520-00-782-2648	Mirror, Mouth Examining, Plane glass, front reflective surface.	ea.	2
6520-00-926-2052	Spatula, Dental, Plastic #42.	ea.	1
6520-00-935-7181	Excavator, Dental, Black's Formula 11.5,7,14; No. 38 and 39.	ea.	1
6520-00-935-7183	Excavator, Dental, Black's Formula 10,6,14; No. 17 and 18.	ea.	1
6520-00-935-7184	Excavator, Dental, Black's Formula 15,8,14; No.36 and 37	ea.	1
6545-00-911-7160	Case, Dental Instrument and Supply Set.	ea.	1
In Compartment 3.			
6505-00-118-1948 P	Aspirin Tablets, USP, .324 g.	bx.	50/100
6505-00-153-8379 P	Eugenol, USP, 1 oz.	bt.	1
6505-00-576-8842 P	Lidocaine Hydrochloride Injection, with Epinephrine 1:100000, Cartridge 1.8 ml.	cn.	1
6510-00-201-3000	Cotton, Purified, USP 1 oz.	pg.	1
6510-00-782-2700	Sponge, Surgical, Gauze, compressed 2" X 2".	pg.	1
6515-00-181-7412	Needle, Hypodermic, Disposable, Cartridge Type, 27 gauge.	bx.	50/100
6515-00-010-8761	Syringe, Cartridge, Aspirating, thumb ring handle.	ea.	1
6520-00-117-7641	Broach Pulp, Medium.	ea.	1
6520-00-180-5965	Forceps, Tooth Extracting, #17	ea.	1
6520-00-532-0150	Forceps, Tooth Extracting, # 53L	ea.	1
6520-00-532-3990	Forceps, Tooth Extracting, # 150	ea.	1
6520-00-532-4990	Forceps, Tooth Extracting, # 151	ea.	1
6520-00-542-2550	Mixing Pad, Parchment Paper, Dental, 6" X 8".	pd.	1
6105-00-299-8591	Bag, Plastic, Button and String closure, 11.5" X 5.5".	hd.	1/100

Table 4.

U.S. Marine Corps Recommendations (20 June 1990)

Pouch Changes:

1. Two Separate Removable Instrument Pouches.
 - a. Exploratory Instruments.
 - b. Surgical Instruments.
2. Puncture Proof Material for Pouches.
3. Internal Holding Pocket for Pouches.

Other Changes:

4. Zipper moved from interior panel to the exterior of the bag for external access to inner compartment.
5. The shoulder strap attachment point nylon tape should be continuous along the bottom of the bag.
6. A short handle should be added to each side.

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